



**ENVIRONMENTAL PROTECTION AGENCY**

**6560-50-P**

**[FRL-9974-37-OAR]**

**Alternative Method for Calculating Off-cycle Credits under the Light-duty Vehicle Greenhouse Gas Emissions Program: Applications from General Motors and Toyota Motor North America**

**AGENCY:** Environmental Protection Agency (EPA).

**ACTION:** Notice.

**SUMMARY:** EPA is requesting comment on applications General Motors (GM), and Toyota Motor North America (Toyota) for off-cycle carbon dioxide (CO<sub>2</sub>) credits under EPA's light-duty vehicle greenhouse gas emissions standards. "Off-cycle" emission reductions can be achieved by employing technologies that result in real-world benefits, but where that benefit is not adequately captured on the test procedures used by manufacturers to demonstrate compliance with emission standards. EPA's light-duty vehicle greenhouse gas program acknowledges these benefits by giving automobile manufacturers several options for generating "off-cycle" carbon dioxide (CO<sub>2</sub>) credits. Under the regulations, a manufacturer may apply for CO<sub>2</sub> credits for off-cycle technologies that result in off-cycle benefits. In these cases, a manufacturer must provide EPA with a proposed methodology for determining the real-world off-cycle benefit. These two manufacturers have submitted applications that describe methodologies for determining off-cycle credits. The off-cycle technologies vary by manufacturer and include thermal control technologies such as high efficiency alternators, an efficient air conditioning compressor, and active climate control seats. Pursuant to applicable

regulations, EPA is making descriptions of each manufacturer's off-cycle credit calculation methodologies available for public comment.

**DATES:** Comments must be received on or before [insert date 30 days after date of publication in the Federal Register].

**ADDRESSES:** Submit your comments, identified by Docket ID No. EPA-HQ-OAR-2017-0754, to the Federal eRulemaking Portal: <http://www.regulations.gov>. Follow the online instructions for submitting comments. Once submitted, comments cannot be edited or withdrawn. The EPA may publish any comment received to its public docket. Do not submit electronically any information you consider to be Confidential Business Information (CBI) or other information whose disclosure is restricted by statute.

Multimedia submissions (audio, video, etc.) must be accompanied by a written comment. The written comment is considered the official comment and should include discussion of all points you wish to make. The EPA will generally not consider comments or comment contents located outside of the primary submission (i.e. on the web, cloud, or other file sharing system). For additional submission methods, the full EPA public comment policy, information about CBI or multimedia submissions, and general guidance on making effective comments, please visit <http://www2.epa.gov/dockets/commenting-epa-dockets>.

**FOR FURTHER INFORMATION, CONTACT:** Roberts French, Environmental Protection Specialist, Office of Transportation and Air Quality, Compliance Division, U.S. Environmental Protection Agency, 2000 Traverwood Drive, Ann Arbor, MI 48105. Telephone: (734) 214-4380. Fax: (734) 214-4869. Email address: [french.roberts@epa.gov](mailto:french.roberts@epa.gov).

## **SUPPLEMENTARY INFORMATION:**

### **I. Background**

EPA's light-duty vehicle greenhouse gas (GHG) program provides three pathways by which a manufacturer may accrue off-cycle carbon dioxide (CO<sub>2</sub>) credits for those technologies that achieve CO<sub>2</sub> reductions in the real world but where those reductions are not adequately captured on the test used to determine compliance with the CO<sub>2</sub> standards, and which are not otherwise reflected in the standards' stringency. The first pathway is a predetermined list of credit values for specific off-cycle technologies that may be used beginning in model year 2014.<sup>1</sup> This pathway allows manufacturers to use conservative credit values established by EPA for a wide range of technologies, with minimal data submittal or testing requirements, as long as the technologies meet EPA regulatory definitions. In cases where the off-cycle technology is not on the menu but additional laboratory testing can demonstrate emission benefits, a second pathway allows manufacturers to use a broader array of emission tests (known as "5-cycle" testing because the methodology uses five different testing procedures) to demonstrate and justify off-cycle CO<sub>2</sub> credits.<sup>2</sup> The additional emission tests allow emission benefits to be demonstrated over some elements of real-world driving not adequately captured by the GHG compliance tests, including high speeds, hard accelerations, and cold temperatures. These first two methodologies were completely defined through notice and comment

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<sup>1</sup> See 40 CFR 86.1869-12(b).

<sup>2</sup> See 40 CFR 86.1869-12(c).

rulemaking and therefore no additional process is necessary for manufacturers to use these methods. The third and last pathway allows manufacturers to seek EPA approval to use an alternative methodology for determining the off-cycle CO<sub>2</sub> credits.<sup>3</sup> This option is only available if the benefit of the technology cannot be adequately demonstrated using the 5-cycle methodology. Manufacturers may also use this option for model years prior to 2014 to demonstrate off-cycle CO<sub>2</sub> reductions for technologies that are on the predetermined list, or to demonstrate reductions that exceed those available via use of the predetermined list.

Under the regulations, a manufacturer seeking to demonstrate off-cycle credits with an alternative methodology (i.e., under the third pathway described above) must describe a methodology that meets the following criteria:

- Use modeling, on-road testing, on-road data collection, or other approved analytical or engineering methods;
- Be robust, verifiable, and capable of demonstrating the real-world emissions benefit with strong statistical significance;
- Result in a demonstration of baseline and controlled emissions over a wide range of driving conditions and number of vehicles such that issues of data uncertainty are minimized;
- Result in data on a model type basis unless the manufacturer demonstrates that another basis is appropriate and adequate.

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<sup>3</sup> See 40 CFR 86.1869-12(d).

Further, the regulations specify the following requirements regarding an application for off-cycle CO<sub>2</sub> credits:

- A manufacturer requesting off-cycle credits must develop a methodology for demonstrating and determining the benefit of the off-cycle technology, and carry out any necessary testing and analysis required to support that methodology.
- A manufacturer requesting off-cycle credits must conduct testing and/or prepare engineering analyses that demonstrate the in-use durability of the technology for the full useful life of the vehicle.
- The application must contain a detailed description of the off-cycle technology and how it functions to reduce CO<sub>2</sub> emissions under conditions not represented on the compliance tests.
- The application must contain a list of the vehicle model(s) which will be equipped with the technology.
- The application must contain a detailed description of the test vehicles selected and an engineering analysis that supports the selection of those vehicles for testing.
- The application must contain all testing and/or simulation data required under the regulations, plus any other data the manufacturer has considered in the analysis.

Finally, the alternative methodology must be approved by EPA prior to the manufacturer using it to generate credits. As part of the review process defined by

regulation, the alternative methodology submitted to EPA for consideration must be made available for public comment.<sup>4</sup> EPA will consider public comments as part of its final decision to approve or deny the request for off-cycle credits.

## **II. Off-Cycle Credit Applications**

### *A. General Motors*

#### **1. High-Efficiency Alternator**

General Motors (GM) is requesting GHG credits for alternators with improved efficiency relative to a baseline alternator. This request is for the 2010 to 2016 model years. Automotive alternators convert mechanical energy from a combustion engine into electrical energy that can be used to power a vehicle's electrical systems. Alternators inherently place a load on the engine, which results in increased fuel consumption and CO<sub>2</sub> emissions. High efficiency alternators use new technologies to reduce the overall load on the engine yet continue to meet the electrical demands of the vehicle systems, resulting in lower fuel consumption and lower CO<sub>2</sub> emissions. Some comments on EPA's proposed rule for GHG standards for the 2016-2025 model years suggested that EPA provide a credit for high-efficiency alternators on the pre-defined list in the regulations. While EPA agreed that high-efficiency alternators can reduce electrical load and reduce fuel consumption, and that these impacts are not seen on the emission test procedures because accessories that use electricity are turned off, EPA noted the difficulty in

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<sup>4</sup> See 40 CFR 86.1869-12(d)(2).

defining a one-size-fits-all credit due to lack of data.<sup>5</sup> GM proposes a methodology that would scale credits based on the efficiency of the alternator; alternators with efficiency (as measured using an accepted industry standard procedure) above a specified baseline value could get credits of 0.16 grams/mile per percent improvement in alternator efficiency. This methodology is similar to that proposed by Ford and published for comment in June of 2017.<sup>6</sup> Details of the testing and analysis can be found in the manufacturer's application.

## 2. Active Climate Control Seats

GM is also applying for off-cycle GHG credits for the use of active climate control seat technologies. Based on GM's analysis, they are requesting credits equal to 2.3 grams CO<sub>2</sub> per mile for passenger cars and 2.9 grams CO<sub>2</sub> per mile for trucks on all models that use these seats in both front seating locations. This request is for a larger amount of credit than could be earned by these designs using the pre-defined regulatory "menu" of default off-cycle credits for ventilated seats (1.0 and 1.3 grams/mile for cars and trucks, respectively).

The technology used by GM uses a combination of ventilation fans and cooling devices. Active cooling to the seat back is provided by the installation of thermoelectric devices (TED) and a blower which provides positive, temperature controlled airflow pushed towards the occupant. The seat cushion also features a blower operating in a pull

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<sup>5</sup> See 77FR 62730, October 15, 2012.

<sup>6</sup> See 82 FR 27819, June 19, 2017.

mode, drawing the air surrounding the occupant into the seat cushion. The foams in both seating surfaces include a textile spacer fabric that facilitates lateral airflow under occupant load. The seat covers are made of cloth and backed by an additional layer of textile spacer fabric to promote airflow to the occupant.

GM performed a series of simulations on three vehicle platforms, demonstrating credit values of 1.7 and 2.1 grams/mile for cars and trucks, respectively. The analysis also accounted for emissions associated with the power consumption of the ventilated seat technology. The request is for these credit levels for 2010-2016 models using active climate control seat technology in both front seating locations.

*B. Toyota Motor North America (Toyota)*

Using the alternative methodology approach discussed above, Toyota is applying for credits for an air conditioning compressor manufactured by Denso that results in air conditioning efficiency credits beyond those provided in the regulations. This request is for the 2013 and subsequent model years. This compressor, known as the Denso SAS compressor, improves the internal valve system within the compressor to reduce the internal refrigerant flow necessary throughout the range of displacements that the compressor may use during its operating cycle. The addition of a variable crankcase suction valve allows a larger mass flow under maximum capacity and compressor start-up conditions (when high flow is ideal), and then it can reduce to smaller openings with reduced mass flow in mid- or low-capacity conditions. The refrigerant exiting the crankcase is thus optimized across the range of operating conditions, reducing the overall energy consumption of the air conditioning system. EPA first approved credits for



General Motors (GM) for the use of the Denso SAS compressor in 2015,<sup>7</sup> and has subsequently approved such credits for BMW, Ford, and Hyundai.<sup>8</sup>

The credits calculated for the Denso SAS compressor would be in addition to the credits of 1.7 grams/mile for variable-displacement A/C compressors already allowed under EPA regulations.<sup>9</sup> However, it is important to note that EPA regulations place a limit on the cumulative credits that can be claimed for improving the efficiency of A/C systems. The rationale for this limit is that the additional fuel consumption of A/C systems can never be reduced to zero, and the limits established by regulation reflect the maximum possible reduction in fuel consumption projected by EPA. These limits, or caps, on credits for A/C efficiency, must also be applied to A/C efficiency credits granted under the off-cycle credit approval process. In other words, cumulative A/C efficiency credits for an A/C system – from the A/C efficiency regulations and those granted via the off-cycle regulations – must comply with the stated limits.

Toyota is requesting an off-cycle GHG credit of 1.1 grams CO<sub>2</sub> per mile for the Denso SAS compressor. Toyota cited the bench test modeling analysis referenced in the original GM application, which demonstrated a benefit of 1.1 grams/mile. Like other manufacturers, Toyota also ran vehicle tests using the AC17 test. Six tests were conducted on a Toyota Corolla, resulting in a calculated benefit of 1.4 grams/mile, thus

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<sup>7</sup> “EPA Decision Document: Off-cycle Credits for Fiat Chrysler Automobiles, Ford Motor Company, and General Motors Corporation.” Compliance Division, Office of Transportation and Air Quality, U.S. Environmental Protection Agency. EPA-420-R-15-014, September 2015.

<sup>8</sup> EPA Decision Document: Off-cycle Credits for BMW Group, Ford Motor Company, and Hyundai Motor Company.” Compliance Division, Office of Transportation and Air Quality, U.S. Environmental Protection Agency. EPA-420-R-17-010, December 2017.

<sup>9</sup> See 40 CFR 86.1868-12.

substantiating the bench test results. Based on these results, Toyota is requesting a credit of 1.1 grams/mile for all Toyota vehicles equipped with the Denso SAS compressor with variable crankcase suction valve technology, starting with 2013 model year vehicles. Details of the testing and analysis can be found in the manufacturer's application.

### **III. EPA Decision Process**

EPA has reviewed the applications for completeness and is now making the applications available for public review and comment as required by the regulations. The off-cycle credit applications submitted by GM and Toyota (with confidential business information redacted) have been placed in the public docket (see ADDRESSES section above) and on EPA's web site at <https://www.epa.gov/vehicle-and-engine-certification/compliance-information-light-duty-greenhouse-gas-ghg-standards>.

EPA is providing a 30-day comment period on the applications for off-cycle credits described in this notice, as specified by the regulations. The manufacturers may submit a written rebuttal of comments for EPA's consideration, or may revise an application in response to comments. After reviewing any public comments and any rebuttal of comments submitted by manufacturers, EPA will make a final decision regarding the credit requests. EPA will make its decision available to the public by placing a decision document (or multiple decision documents) in the docket and on EPA's web site at the same manufacturer-specific pages shown above. While the broad methodologies used by these manufacturers could potentially be used for other vehicles and by other manufacturers, the vehicle specific data needed to demonstrate the off-cycle

emissions reductions would likely be different. In such cases, a new application would be required, including an opportunity for public comment.

Dated: February 6, 2018.

**Byron Bunker**

**Director, Compliance Division**

*Office of Transportation and Air Quality*

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